THE EFFECTS OF S-TRIAZINES ON SELECTED MARINE MACROALGAE

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Although s-triazines have been used as herbicides for many years, their use and that of other herbicides and fungicides, in antifouling compounds is only fairly recent. Very little published data exists concerning the toxicity of these compounds on non target marine algae and other organisms [1]. Research in UK suggests that in the years following the introduction of triazines as an active ingredient in antifouling paints, there has been an increase in the levels of triazines found in waters with high boating activity [2].The Hamble estuary, Hampshire UK has been identified as one such site. Investigations were conducted into the effects of s-triazines on selected marine macroalgae, local to that area.

Initially the investigation looked at the lethal effects of triazines on a range of macroalgae local to the hamble estuary. Pilot results on a limited number of common algae, indicated that only *Ceramium rubrum,* a red alga was susceptible to terbutryn at concentration less than 100 mg L^{-1} . With all other test algae showing no measurable effect at concentrations up to 100 mg L^{-1} . Other investigations indicated that sporelings were more susceptible than adult plants. Table 1 shows at LC_{50} (mg L^{-1}) values at four days for a wider range of algae. It can be seen that the most susceptible algae are *Fucus spiralis* and *C. rubrum,* mid to low shore species. The most resistant algae were the two large, mid shore species, *Ascophyllum nodosum* and *Himanthalia elongata.* The mid to upper shore species, *Ulva* spp and *Enteromorpha* sp, being moderately resistant to s-triazine.

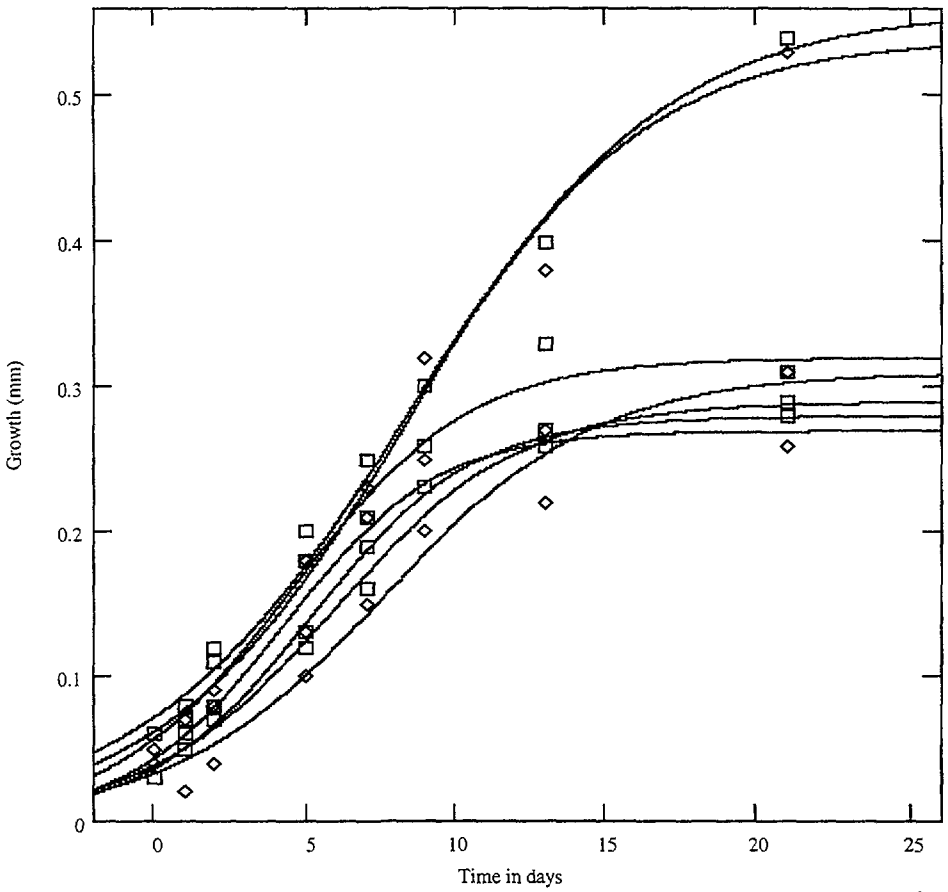
TABLE I. LC_{50} (mgL^{-1}) VALUES AT FOUR DAYS FOR S-TRIAZINES ON MARINE MACROALGAE

Alga	LC_{50} (mgL^{-1})
Ulva spp	25
Enteromorpha sp	20
Fucus spiralis	16
F.vesiculosus	25
Ascopyllum nodosum	66
Himanthalia elongata	100
Ceramium rubrum	17

Initially it appeared that the sensitiveness of the algae to s-triazine may be due to the position on the beach. However, consideration should also be given to the effect of the robust physical nature of the resistant species. All species seem to be tolerant to s-triazines than reported at other sites [3]. Algae, from a study near Plymouth, were taken from sites with very low levels of s-triazine. Algae from this study which were taken from s-triazine polluted sites. This leads to the suggestion that some algae may in fact may become resistant to pollution levels. Work is continuing in this area.

Growth experiments were conducted to investigate the sub lethal effects of s-triazines on marine algae. Apical sections of *F.vesiculosus* were grown in varying s-triazine concentrations over a range of temperatures for 21 days. Logistic curves were fitted to the algal growth data. Figure 1 show the effects of s-triazine on the growth at 22°C. It can be seen that concentrations of greater than significantly reduce the growth rate of *F.vesisculosus* after seven days exposure. At 15°C the growth of the alga is significantly reduced by concentrations of 10 mg L^{-1} but with the significance in growth reduction seen earlier at five days.

Fig 1 the effects of s-triazine on the growth of *F. vesiculosus* at 22 °C.



NB.Plots from top to bottom 0,1,10,25,50,75,&100 mg L^{-1}

Results from further experiments indicate that s-triazines affect the developmental growth of *F.vesiculosus* in the form apical division, the fertility of *F.vesiculosus*. Bifurcate division of the apical regions is significantly reduced in concentrations greater than 1 mg L^{-1} , and a significant reduction in the number of experimental plants becoming fertile at 10 mg L^{-1} . Preliminary experiments growing algae in varying levels of the toxin and salinity, indicate that salinity may play a significant role int he uptake of antifouling toxins by marine algae.

It can be seen that s-triazines, while be lethal to marine algae at levels higher than those reported to date, may well have a toxic effect at sublethal levels. S-triazines are photosynthetic inhibitors, a reduction in the photosynthetic effort will lead to a general reduction in metabolism. This is manifesting itself as a reduction in the growth, development and reproduction of these. The eventual environmental consequence will be a reduction in the algal biomass of coastal areas. While there is some indication the populations can adapt to these levels other indicators point to an increased stress by salinity variations leading to even more complicated picture of toxicity existing in estuaries, where boating activity is high..

References

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